CLAIMS

1. An electron source that includes a field emitter, a substrate, a source of charge carriers, at least one ballast resistor, wherein

the field emitter is implemented of a whisker epitaxially grown on the substrate;

at least one ballast resistor is implemented as a barrier which is represented as a boundary in the body of the field emitter , the boundary being formed by contact of materials with different kinds of conductivity.

2. The electron source according to the claim 1, wherein the field emitter is implemented of at least one semiconductor material.

3. The electron source according to the claim 2, wherein at least one barrier is formed by junction of materials with different kinds of conductivity, such as n, n^-, p, p^- kinds.

4. The electron source according to any of the claims 1-3, wherein at least one barrier is formed by an insulating layer that is across to the direction of the charge carriers flow.

5. The electron source according to any of the claims 1-4, wherein the field emitter is formed by a tip.

6. The electron source according to any of the claims 1-5, wherein the field emitter consists of two coaxial parts, a broad lower part and a more narrow upper part.

7. The electron source according to any of the claims 1-4, wherein the field emitter is formed by a blade.

8. The electron source according to any of the claims 1-7, wherein the top of the field emitter is sharpened and coated by diamond or diamond-like material.

9. The electron source according to the claim 8, wherein the diamond or diamond-like coating is sharpened.

10. An electron source that includes a field emitter, a substrate, a source of charge carriers, at least one ballast resistor, wherein

the field emitter is implemented of a whisker epitaxially grown on the substrate;

at least one ballast resistor is implemented as a barrier formed by a boundary between a field emitter body and a conducting layer placed on a surface of the field emitter.

11. The electron source according to the claim 10, wherein at least one ballast resistor is implemented as a barrier which is represented as a boundary in field emitter body, the boundary being formed by contact of the materials with different kinds of conductivity.

12. The electron source according to any of the claims 10, 11, wherein the field emitter is implemented of at least one semiconductor material.

13. The electron source according to any of the claims 10-12, wherein the conducting layer is implemented of at least one semiconductor material.

14. The electron source according to any of the claims 10-13, wherein at least one barrier is formed by junction of materials with different kinds of conductivity, such as n, n^-, p, p^- kinds.

15. The electron source according to any of the claims 10-14, wherein at least one barrier is formed by insulating layer that is across to direction of charge carriers flow.

16. The electron source according to any of the claims 10-15, wherein the field emitter is formed by a tip.

17. The electron source according to any of the claims 10-16, wherein the field emitter consists of two coaxial parts, a broad lower part and a more narrow upper part.

18. The electron source according to any of the claims 10-15, wherein the field emitter is formed by a blade.

19. The electron source according to any of the claims 10-18, wherein the top of the field emitter is sharpened and coated by diamond or diamond-like material.

20. The electron source according to the claim 19, wherein the diamond or diamond-like coating is sharpened.

21. The electron source according to any of the claims 10-20, wherein the source of the charge carriers is connected to field emitter via substrate and/or a conducting layer placed on a surface of the field emitter directly or via an insulator layer.

22. An electron source that includes a field emitter, a substrate, a source of charge carriers, at least one ballast resistor, wherein

the substrate has a shape of a tip and is formed by insulator and by a conductive layer;

the ballast resistor is implemented by the layer.

23. The electron source according to the claim 22, wherein the conductive layer contains at least one barrier for charge carriers.

24. The electron source according to any of the claims 22, 23, wherein at least one barrier is formed by junction of materials with different kinds of conductivity, such as n, n^+, p, p^- kinds.

25. The electron source according to any of the claims 22-24, wherein at least one barrier is formed by insulating layer that is across to direction of charge carriers flow.

26. A controlled electron source that includes a field emitter, a substrate, a source of charge carriers, at least one ballast resistor and at least one control electrode, wherein

it contains an electron source implemented according to claims 1-25.

27. The controlled electron source according to the claim 26, wherein it contains at least one active area in the body and/or on the surface of the field emitter.

28. The controlled electron source according to any of the claims 26, 27, wherein it contains at least one active area in a conducting layer placed on the surface of the substrate and/or of the field emitter directly or via an insulator layer.

29. The controlled electron source according to any of the claims 26-28, wherein at least one control electrode is placed close to one of the barrier for charge carriers.

30. The controlled electron source according to any of the claims 26-29, wherein at least one control electrode placed on side surface of the field emitter via an insulator layer.

31. The controlled electron source according to any of the claims 26-30, wherein it contains at least one control electrode that is separated from the field emitter by a vacuum gap.

32. The controlled electron source according to any of the claims 26-31, wherein at least one control electrode placed along the field emitter.

33. The controlled electron source according to any of the claims 26-32, wherein control electrode has a direct contact with the side surface of the field emitter.

34. The controlled electron source according to any of the claims 26-33, wherein the electron source according to any of the claims 1-21 a substrate is crystalline.

35. The controlled electron source according to any of the claims 26-34, wherein the electron source according to any of the claims 1-21 a substrate is implemented by an insulator and a conductive layer placed on the insulator.

36. The controlled electron source according to any of the claims 34, 35, wherein the substrate or the conductive layer of the substrate is implemented of the monocrystalline material with orientation (111).

37. The controlled electron source according to any of the claims 26-36, wherein its surface is coated by a material which is transparent for electrons, and which prevents outlet of chemical elements from the surface of controlled electron source.

38. The controlled electron source according to the claim 37, wherein the material is diamond or diamond-like carbon.

39. A matrix system of the controlled electron sources containing at least two controlled electron sources, wherein

at least one of the sources implemented according to any of the claims 26-38.

40. The matrix system according to the claim 39, wherein it contains a two-dimensional system of mutually perpendicular rows of the controlled electron sources.

41. The matrix system according to any of the claims 39, 40, wherein at least one control electrode in the controlled electron sources has a diaphragm shape and is implemented of conductive diamond or diamond-like material.

42. The matrix system according to any of the claims 39-41, wherein the substrate represents rows of conductive material placed on insulator.

43. The matrix system according to any of the claims 39-42, wherein the controlled electron sources are provided by conductive buses which form two systems buses of each of the systems are mutually parallel, the buses of the two different systems are mutually perpendicular, the two systems being placed in two levels and separated by insulator.

44. A method for preparation of controlled electron sources including

a formation on a solid substrate of field emitters each of that contains at least one transverse junction formed by materials having different electrical conductivity;

a formation of at least one controlled electrode close to such junctions;

wherein

the field emitters are implemented of whiskers epitaxially grown by the vapor-liquid-solid mechanism.

45. The method according to the claim 44, wherein the implementation of the field emitters includes

formation of the hollows in the substrate;

deposition of solvent particles at the bottom of the hollows.

46. The method according to the claim 44, wherein the implementation of the field emitters includes

placing of solvent particles on the substrate;

etching of the substrate around the particles.

47. The method according to any of the claims 45, 46, wherein further procedure for formation of the field emitters includes

placing of a source material, having a first kind of conductivity, opposite to the substrate with the solvent particles on it;

growing of whiskers having the first kind of conductivity;

stabilized cooling of the grown whiskers, having the globules on its tops, with an introduction of an inert gas into atmosphere, with simultaneous decreasing of the temperature of the substrate;

changing of the source material for another source having a second kind of conductivity;

stabilized heating of the grown whiskers, having the globules on its tops, with an introduction of an inert gas into atmosphere, with simultaneous increasing of the temperature of the substrate;

growing of whiskers having the second kind of conductivity;

48. The method according to the claim 47, wherein the change of the source materials is implemented more than two times.

49. The method according to any of the claims 45, 46, wherein further procedure for formation of the field emitters includes

growing of whiskers in a gaseous atmosphere containing the element or elements of which the substrate consists;

introduction of doping gaseous compounds into the gas atmosphere.

50. The method according to the claim 49, wherein the formation of the field emitters includes more than one procedure of introduction into the gas atmosphere of different gaseous doping compounds.

AS AMENDED

99 claims